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Summary of the workshop on energy efficiency opportunities while phasing down hydrofluorocarbons

Note by the Secretariat

1. The annex to the present note contains a summary of the workshop on energy efficiency opportunities while phasing down hydrofluorocarbons that was held in Vienna on 9 and 10 July 2018.

2. The summary, which is set out in the annex to the present note, is reproduced as received by the Secretariat, without formal editing.

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Annex

Summary of the workshop on energy efficiency opportunities while phasing down hydrofluorocarbons (Vienna, 9 and 10 July 2018)

Introduction

1. Under the Kigali Amendment to the Montreal Protocol, parties recognized the importance of maintaining and/or enhancing energy efficiency while transitioning away from high-global-warming-potential (GWP) hydrofluorocarbons (HFCs) to low-GWP alternatives in the refrigeration, air-conditioning and heat-pump sectors. Parties also recognized that maintaining and/or enhancing energy efficiency could have significant climate benefits.

2. A one-and-a-half-day workshop on energy efficiency opportunities while phasing down HFCs was convened in accordance with decision XXIX/10 (para. 4) taken by the parties to the Montreal Protocol on Substances that Deplete the Ozone Layer at their twenty-ninth Meeting, held jointly with the eleventh meeting of the Conference of the Parties to the Vienna Convention for the Protection of the Ozone Layer, in Montreal (20–24 November 2017).

3. The objectives of the workshop were to provide an opportunity for parties and other stakeholders to discuss in depth:

(a) The types of technical opportunities that can be adopted to improve the energy efficiency of both new and existing refrigeration, air-conditioning and heat-pump (RACHP) equipment, as well as improvements to building design

(b) The barriers to these opportunities and the ways in which barriers can be overcome through appropriate policy measures and investments

(c) The connections between Montreal Protocol activities to phase down HFCs and other activities that are addressing energy efficiency issues in the RACHP sectors.

4. The workshop involved 34 speakers, supported by six session facilitators and seven rapporteurs. The more than 450 participants came from governments, industry and industry associations, international and non-governmental organizations, academic institutions, consulting firms and other organizations. Sessions included presentations and panel discussions, with opportunities for all participants to contribute through questions and statements addressed to the speakers, including through a smartphone application that allowed questions to be submitted electronically.

5. The three main sections of the workshop addressed:

(a) The overall context of energy efficiency in the refrigeration, air-conditioning and heat-pump sectors

(b) Technical opportunities for improving RACHP energy efficiency

(c) Investment, financial and policy measures that encourage improved cooling efficiency, and the potential relationship between energy efficiency policies and the Kigali Amendment.

6. Three briefing notes distributed by the Ozone Secretariat in advance of the workshop helped participants better understand energy efficiency issues.

7. The present document summarizes the key issues raised in each session of the workshop, including those raised in presentations and in subsequent question-and-answer sessions with participants.

A. Background to energy efficiency in the refrigeration, air-conditioning and heat-pump sectors

8. The objective of the session was to set the scene by examining overarching issues and challenges to improving energy efficiency in the RACHP sectors.

9. RACHP use in Article 5 countries is expected to more than double by 2030 and more than triple by 2050. Currently, refrigerant emissions and energy use in the RACHP sectors both contribute to global warming, with energy use accounting for more than 80 per cent of the sectors' combined carbon footprint. As a consequence, various interventions will be required to avoid a very large increase in energy demand from the use of RACHP equipment. According to the International Energy

Agency, almost half of the near-term reductions in emissions required to meet the goals of the Paris Agreement can be achieved by adopting cost-effective energy efficiency measures, including in the RACHP sector. Global energy efficiency improved by 13 per cent overall between 2000 and 2016, but progress has since slowed because of a reduction in the number of energy efficiency policies enacted and a decrease in energy prices.

10. There is significant technical potential to reduce RACHP energy consumption by reducing cooling loads; minimizing the temperature lift; accounting for variable operating conditions; selecting the most efficient refrigeration cycle, refrigerant and components; designing effective control systems; monitoring operating performance; and correcting faults.

11. Despite the excellent potential that exists, uptake of energy efficiency measures is slow owing to a lack of understanding of how to improve energy efficiency, poor design and selection of equipment, a lack of monitoring and analysis of performance, and narrow financial analysis that does not value the multiple benefits of energy efficiency improvements.

12. As an example of the benefits and challenges of improving energy efficiency, several presentations highlighted the fact that requiring all new air-conditioning units to be very efficient would cut growth in demand for cooling energy by half. If combined with efficient building design, this would completely eliminate growth in the use of energy for space cooling. The average energy efficiency of air conditioners currently on the market is less than half that of efficient products available in most markets, and one third that of the best available technology. Consumers tend to buy the least expensive units even though the extra capital cost of a more energy-efficient unit is usually recovered within one to three years from the resulting energy savings.

13. The introduction of high-energy-efficiency technologies often creates an initial "price hump" that can make them less competitive than conventional technologies. The size and duration of this hump can be reduced through appropriate policies and financial interventions, such as minimum energy performance standards (MEPS), grants and low-cost loans, and bulk procurement programmes. Presenters and some participants advocated for an integrated approach that links efficiency with the refrigerant transition.

14. Given its many benefits, energy efficiency is best seen as an enabler of sustainable development; RACHP goes far beyond comfort and has positive impacts on food safety, health and many other elements of the Sustainable Development Goals.

B. The technical potential for improving energy efficiency in the refrigeration, air-conditioning and heat-pump sectors

15. Two workshop sessions aimed to outline the technical potential for improving the energy efficiency of new RACHP products (session 2) and existing RACHP products (session 3).

1. New products

16. Presentations highlighted the wide range of new RACHP products that have large energy efficiency improvements compared to older designs; energy savings of well over 50 per cent were illustrated through a number of presentations. Some examples described were:

(a) Reductions in cooling demand through such measures as ventilation cooling, improved building design, doors on retail display cases, and LED lighting;

(b) Improved thermodynamic performance of certain refrigeration cycles and refrigerants, including CO_2 trans-critical systems for retail applications and R-290 for movable room air conditioners;

(c) Improved system components, such as inverter-driven compressors, electronic expansion valves, ejectors and new heat exchanger designs;

(d) Improved control systems at the product, system and building automation system levels.

17. Refrigerant selection is an important design consideration for RACHP equipment. The properties of alternative refrigerants relevant for refrigerant selection included energy efficiency, flammability, toxicity and so on. The direct impact of refrigerant selection on overall energy efficiency is typically in the plus or minus 5 to 10 per cent range. Reducing leaks through proper installation practices and good design – for example, by minimizing joints and using brazed rather than mechanical connections – reduces refrigerant emissions and helps maintain energy efficiency over the life of the equipment.

18. MEPS drive the market for energy-efficient equipment. The use of MEPS has yielded positive results in countries around the world, including those with high ambient temperatures. The design of equipment to be used in high-ambient-temperature settings must take into account the high heat loads and very high condensing temperatures.

19. The benefits of a holistic approach and the need to look at building envelope and insulation technologies as well as effective service and refrigerant management were emphasized.

20. Finally, improving energy efficiency in the cold chain helps reduce food waste.

2. Existing products

21. Examples were given of a wide range of opportunities for improving the performance of existing equipment through better control and monitoring and improved maintenance. Several presenters described savings in the 10 to 30 per cent range, with a few examples given of even higher savings. Improving efficiency typically also extends the operating life of equipment. Some key techniques described by presenters included:

(a) Improved metering that identifies poorly performing equipment and maintenance issues

(b) Cleaning of heat exchangers and filters

(c) Ensuring good airflow around heat exchangers

(d) Monitoring and repairing refrigerant leaks.

22. Many presentations stressed the importance of training service technicians to ensure that they understand their role in improving the energy efficiency of RACHP equipment. Experience shows that training is most effective when it includes both theoretical and practical assessments. Refresher training and requalification for new equipment and refrigerants should be incorporated into training requirements. Training should cover leak detection and repairs, equipment cleaning, equipment and control settings, and safety considerations. The provision of information on basic system maintenance to customers and end users can also be important.

23. The discussions highlighted the need for more information comparing the energy efficiency of low-GWP refrigerants to that of hydrochlorofluorocarbons (HCFCs) and HFCs. It was also noted that energy efficiency issues related to maintenance seemed to be common to all types of refrigerants. That view was echoed by the panel members.

C. Investment and financing opportunities

24. The objective of this session was to give an overview of opportunities, experiences and challenges relating to the funding of energy efficiency projects in the RACHP sectors.

25. Governments and development banks have climate targets that can be drivers for increasing energy efficiency. Energy efficiency would improve more rapidly, however, if it were seen as a means to an end. More emphasis should be put on the services that people desire and are willing to pay for, and that financial institutions will therefore support. For example, governments are particularly interested in energy security, industry in productivity, hospitals in safe vaccines, and schools in improving students' performance.

26. While it is often difficult to commoditize energy efficiency projects because different types of projects require different approaches and tailored financial mechanisms, standardization and certification schemes can help by providing greater certainty in terms of performance and creating larger markets for products and services. These developments in turn create business opportunities for equipment suppliers and energy service companies. While such companies have not been universally successful, driven by the notion that "where there is a margin there is a market", they have delivered large-scale energy efficiency investments in China and India; lessons learned from these countries could benefit others. Energy service companies can facilitate financial flows by identifying solutions for overcoming barriers, taking on technical risks, and aggregating large numbers of small projects in order to reduce transaction costs for banks, as has been done successfully by Energy Efficiency Services Limited of India.

27. Energy efficiency projects often have difficulty attracting financing. They are often relatively small, and the benefits accrue not only to the investor, in terms of energy cost savings, but to the broader economy and society – for example, by reducing the need to invest in supply infrastructure or by reducing CO_2 emissions. In other words, even though both public and private stakeholders benefit from improvements in energy efficiency, the up-front costs are not shared.

28. Perceived risks need to be addressed, and real risks need to be managed. There is some evidence that local financial institutions do not take international energy efficiency programmes seriously.

29. It is generally held that, while sufficient funds are available, these do not always flow effectively in the case of energy efficiency projects. It was suggested that a catalogue of funding opportunities be developed as an information source for parties.

D. Policies for improving the energy efficiency of refrigeration, air-conditioning and heat-pumping appliances and systems

30. Two sessions explored policy measures that encourage the uptake of higher-efficiency RACHP products. The first dealt with policies governing domestic appliances and the second with those for larger systems.

31. For domestic appliances, the presentations described three main policy mechanisms: MEPS, energy-labelling programmes and demand response strategies.

32. Many countries around the world are successfully using MEPS to drive markets for more efficient appliances, often in combination with labelling programmes. Mandatory MEPS have been successful both in countries that manufacture energy-using products and in those that import most of their products. It is widely held that mandatory MEPS are the most effective policy measures for removing the least efficient products from the market.

33. Energy labels are voluntary or mandatory mechanisms for encouraging purchases of appliances with performance exceeding the minimum standard. Mandatory comparative labels such as those used in China, Ghana and the European Union and in many other countries help consumers choose more efficient products, while voluntary endorsement labels like the Energy Star label used in the United States of America help consumers choose the most efficient products and drive the market towards higher-efficiency products. Trust in brands is an important aspect of any labelling programme. Market surveillance is important for guaranteeing the success of such programmes. Standards and labels need to be regularly reviewed and updated.

34. Some appliances, such as air conditioners, can be remotely controlled through smartphone applications to reduce or shift periods of peak demand. This is particularly useful when variable renewable energy resources are being integrated into electricity grids. In Australia, for example, one in four houses has rooftop solar panels, and consumers are given incentives to reduce peak demand for power. While these systems are in early stages of development, they could make major contributions to reducing peak energy demand for cooling.

35. For larger equipment, utility demand-side management programmes can overcome some of the barriers to investment in energy efficiency. Utility companies can provide both technical expertise and financing and monetize the financial benefits of reducing peak demand on the electricity grid.

36. Bulk procurement was described as a mechanism that can reduce the size of the capital cost "hump" that occurs when innovative highly energy efficient products reach the market. A bulk procurement business model can work with both domestic appliances and larger RACHP equipment.

37. A presentation on cold chains described how, in some regions, up to 40 per cent of food produced is lost owing to the lack of an integrated cold chain that connects producers to markets and consumers. According to a recent United Nations report, only one in three fish caught ever reaches a plate. The use of small diesel engines on refrigerated lorries creates localized air pollution as well as CO_2 emissions. Alternative approaches to transport refrigeration can overcome some of these issues.

38. District cooling uses economies of scale to save significant amounts of energy, especially in high-ambient-temperature locations, where 70 per cent of electricity consumption goes towards cooling. When district cooling is used in appropriate circumstances, efficiency improvements of over 40 per cent can be achieved.